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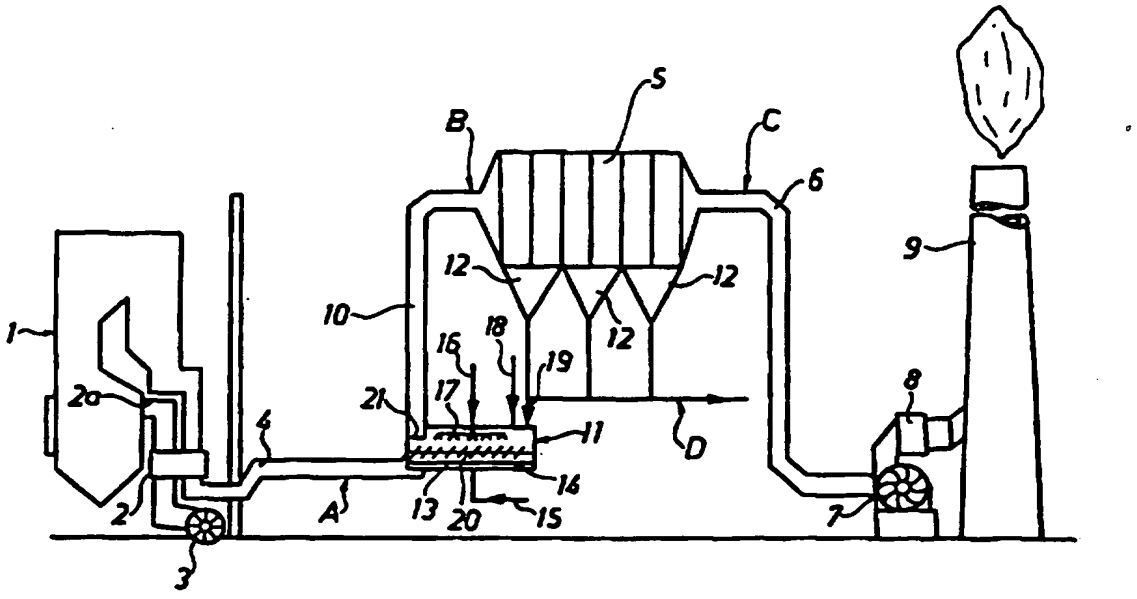
(54) Title: METHOD FOR SEPARATING GASEOUS POLLUTANTS FROM HOT PROCESS GASES



(57) Abstract

Hot process gases are passed through a contact reactor (10), in which a particulate absorbent material, which is reactive with gaseous pollutants in the gases, is introduced into the gases to convert the gaseous pollutants into separable dust. The process gases are then passed through a dust separator (5). The major part of the dust separated in the dust separator (5) is passed to a mixer (11), in which it is mixed and moistened, whereupon it is recirculated as absorbent material by being introduced, together with fresh absorbent, into the process gases. Burnt lime is added as fresh absorbent. The dust is kept so long in the mixer and recirculated so many times that the total residence time of the burnt lime in the mixer in moistened state is sufficiently long for the burnt lime to react substantially completely with water supplied to the mixer and form slaked lime.

METHOD FOR SEPARATING GASEOUS POLLUTANTS FROM HOT PROCESS GASES

The present invention relates to a method for separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, in which method the process gases are passed through a contact reactor, in which a particulate absorbent material, which is reactive with the gaseous pollutants, is introduced in moistened state into the process gases for converting the gaseous pollutants into separable dust, whereupon the process gases are passed through a dust separator, in which dust is separated from the process gases and from which the cleaned process gases are discharged, part of the dust separated in the dust separator being passed to a mixer, in which it is mixed and supplied with water so as to be moistened, whereupon it is recirculated as absorbent material by being introduced into the process gases together with an addition of fresh absorbent.

The above-described method for separating gaseous pollutants from hot process gases is known from e.g. SE 8504675-3 and SE 8904106-5. According to these two documents, use is preferably made of slaked lime (calcium hydroxide) in particle form as fresh absorbent. This absorbent is mixed with dust which has been separated from the process gases in the dust separator, whereupon the mixture is supplied with water to be introduced, in moistened state, into the flue gases in the contact reactor. The slaked lime is comparatively expensive, and so various experiments have been made to use burnt lime (calcium oxide) instead, which is considerably less expensive. In these experiments, a plant had to be used, in which the burnt lime has first been slaked, i.e. the calcium oxide has been caused to react with water to form calcium hydroxide, before being introduced into the cleaning process. Such a lime slaking plant is expensive,

which means that the expected profit when changing from slaked lime to burnt lime failed to appear.

The object of the present invention is to provide a method for separating gaseous pollutants from hot process gases, in which the slaked lime can be replaced by burnt lime, without necessitating an expensive, separate plant for slaking the burnt lime.

According to the invention, this object is achieved by a method which is of the type mentioned by way of introduction and is characterised in that burnt lime is added as fresh absorbent, and that the major part of the dust separated in the dust separator is supplied to and discharged from the mixer in a substantially continuous flow, the dust being kept so long in the mixer and being recirculated so many times that the total residence time of the burnt lime in the mixer in moistened state is sufficiently long for the burnt lime to have time to react substantially completely with water supplied to the mixer and form slaked lime.

The fresh absorbent in the form of burnt lime is supplied preferably to the mixer, but it may also be added to that part of the dust separated in the dust separator which is supplied to the mixer. Alternatively, the burnt lime can be introduced directly into the flue gases in the contact reactor.

An air flow is suitably supplied to the mixer in order to fluidise the dust mixed therein and thus improve the mixture.

The invention will now be described in more detail with reference to the accompanying drawing, which schematically illustrates a plant for cleaning flue gases from a coal-fired central heating plant, the cleaning plant being provided with equipment for carrying out the method according to the present invention.

The drawing schematically illustrates a plant for cleaning flue gases from a coal-fired central heating plant 1, said flue gases containing dust, such as fly

ash, and gaseous pollutants, such as sulphur dioxide. A preheating device 2 is arranged to transmit heat from the hot flue gases to combustion air, which via a duct 2a is supplied to the central heating plant 1 by means of a fan 3.

The hot flue gases are conveyed through a duct 4 to a dust separator 5, which in the embodiment shown is an electrostatic precipitator having three successive precipitator units, through which the flue gases are passed to be cleaned. The flue gases cleaned in this manner are via a duct 6 passed to a flue gas fan 7, which via a duct 8 feeds them on to a chimney 9 to be emitted into the atmosphere. The dust separator can also be a bag filter.

The duct 4 comprises a vertical portion which forms a contact reactor 10. A mixer 11 communicates with the contact reactor 10 in the lower part thereof. The mixer 11 introduces a particulate absorbent material, which is reactive with the gaseous pollutants in the flue gases, in moistened state into the flue gases in the lower part of the contact reactor 10. This absorbent material converts the gaseous pollutants into dust, which is separated in the precipitator 5.

The dust particles separated in the precipitator 5 are collected in the hoppers 12 of the precipitator units. The major part of the collected dust particles is recirculated in the system in a manner which will be described in detail below. The remainder of the collected dust particles are transported away in a manner which will not be described in detail, for instance by means of a worm conveyor.

The mixer 11 is of the type as described in SE-9404104-3. Thus, the mixer 11 has essentially the shape of a double-bottom box. Between the two bottoms, the upper of which consists of a tensioned fluidising cloth 13 of polyester, there is a chamber 14, to which air for fluidising the particulate absorbent material in the mixer 11 is conducted through an air supply conduct 15.

Water is supplied to the mixer 11 through a water supply conduit 16 and nozzles 17, which are arranged in the upper portion of the mixer. The particulate material which is to be mixed, is supplied to the mixer 11 through two material inlets 18 and 19 at the inlet end of the mixer. The mixer 11 further comprises a mechanical mixing mechanism 20 consisting of two cooperating, parallel agitators (of which only one is shown in the drawing), each having a horizontal shaft and, mounted thereon, a plurality of inclined elliptic plates. The outlet end of the mixer 11 extends into the contact reactor 10 in order to continuously supply thereto through an overflow 21 well-mixed, moistened absorbent material.

That part of the dust particles collected in the hoppers 12 of the precipitator units which is to be recirculated in the system is supplied to the mixer 11 through the inlet 19. Particulate burnt lime (calcium oxide) is supplied to the mixer 11 through the inlet 18 to be mixed with the dust particles supplied through the inlet 19. The mixture is moistened with water supplied through the nozzles 17. Water is supplied through the nozzles 17 also in order to slake the burnt lime supplied to the mixer 11. Owing to the construction of the mechanical mixing mechanism 20 and the fluidisation of the material particles supplied to the mixer 11, the mixer produces a homogeneously moistened, homogeneous mixture of material particles, which are, through the overflow 21 of the mixer 11, continuously supplied to the contact reactor 10 as absorbent material. The residence time of the material particles in the mixer 11 is in the order of 5-60 s, especially 10-20 s.

The residence time as stated above (10-20 s) of the material particles in the mixer 11, i.e. the time during which the lime particles are in moistened state, is insufficient for the burnt lime to have time to react completely with the water added for slaking and form slaked

lime. Such a reaction is relatively slow and takes several minutes.

The invention will now be described in more detail with the aid of the theoretical Example below. The Example states the conditions prevailing at points A, B and C in the drawing, i.e. in the duct 4 before the mixer 11, in the reactor 10 after the mixer 11 at the inlet of the precipitator 5 and at the outlet of the precipitator 5, respectively.

	A	B	C
Gas flow (Nm^3/h)	100,000	103,993	103,993
Gas temperature (°C)	125	65	65
SO_2 concentration (ppm)	1,150	280	172
Dust concentration (g/Nm^3)	20	1,000	< 0.03

The dust at A is substantially fly ash, whereas the dust at B is fly ash and absorbent material.

At D, 2,930 kg of dust are discharged per hour, 2,000 kg being fly ash.

In this Example, the particulate absorbent material, including the burnt lime, which is being slaked, is thus circulated on the average about 35 times (1.0 x 103,933 / 2,930 ≈ 35) in the system before being discharged at D. The total residence time of the absorbent material in the mixer 11 thus is 350-700 s, i.e. in the order of 6-12 min, which is sufficient for the burnt lime to have time to be slaked.

The total consumption of water in the above Example is 3,366 l/h, of which 152 l/h is required for the slaking of lime. When this amount of water is consumed, the moisture content of the absorbent material discharged from the mixer 11 is about 6%. However, the moisture content can, according to the composition of the mixture, suitably be varied in the range 2-15%.

If, in the above Example, the fly ash content of the flue gases at point A is zero, i.e. the discharge at D is

930 kg/h, the circulation number will, by analogy with that stated above, be about 110 (0.980 x 103,993 / 930 ≈ 110), which in turn yields a residence time of 1,100-2,200 s, i.e. in the order of 18-37 min.

CLAIMS

1. A method for separating gaseous pollutants, such as sulphur dioxide, from hot process gases, such as flue gases, in which method the process gases are passed through a contact reactor (10), in which a particulate absorbent material, which is reactive with the gaseous pollutants, is introduced in moistened state into the process gases for converting the gaseous pollutants into separable dust, whereupon the process gases are passed through a dust separator (5), in which dust is separated from the process gases and from which the cleaned process gases are discharged, part of the dust separated in the dust separator (5) being passed to a mixer (11), in which it is mixed and supplied with water so as to be moistened, whereupon it is recirculated as absorbent material by being introduced into the process gases together with an addition of fresh absorbent, c h a r a c t e r i s e d in that burnt lime is added as fresh absorbent, and that the major part of the dust separated in the dust separator (5) is supplied to and discharged from the mixer (11) in a substantially continuous flow, the dust being kept so long in the mixer and being recirculated so many times that the total residence time of the burnt lime in the mixer (11) in moistened state is sufficiently long for the burnt lime to have time to react substantially completely with water supplied to the mixer and form slaked lime.

2. The method as claimed in claim 1, c h a r a c t e r i s e d in that the fresh absorbent in the form of burnt lime is supplied to the mixer (11).

3. The method as claimed in claim 1, c h a r a c t e r i s e d in that the fresh absorbent in the form of burnt lime is added to that part of the dust separated in the dust separator (5) which is supplied to the mixer (11).

4. The method as claimed in claim 1, c h a r a c - t e r i s e d in that the fresh absorbent in the form of burnt lime is introduced directly into the flue gases in the contact reactor (10).

5. The method as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that an air flow is supplied to the mixer (11) in order to fluidise the dust mixed therein.

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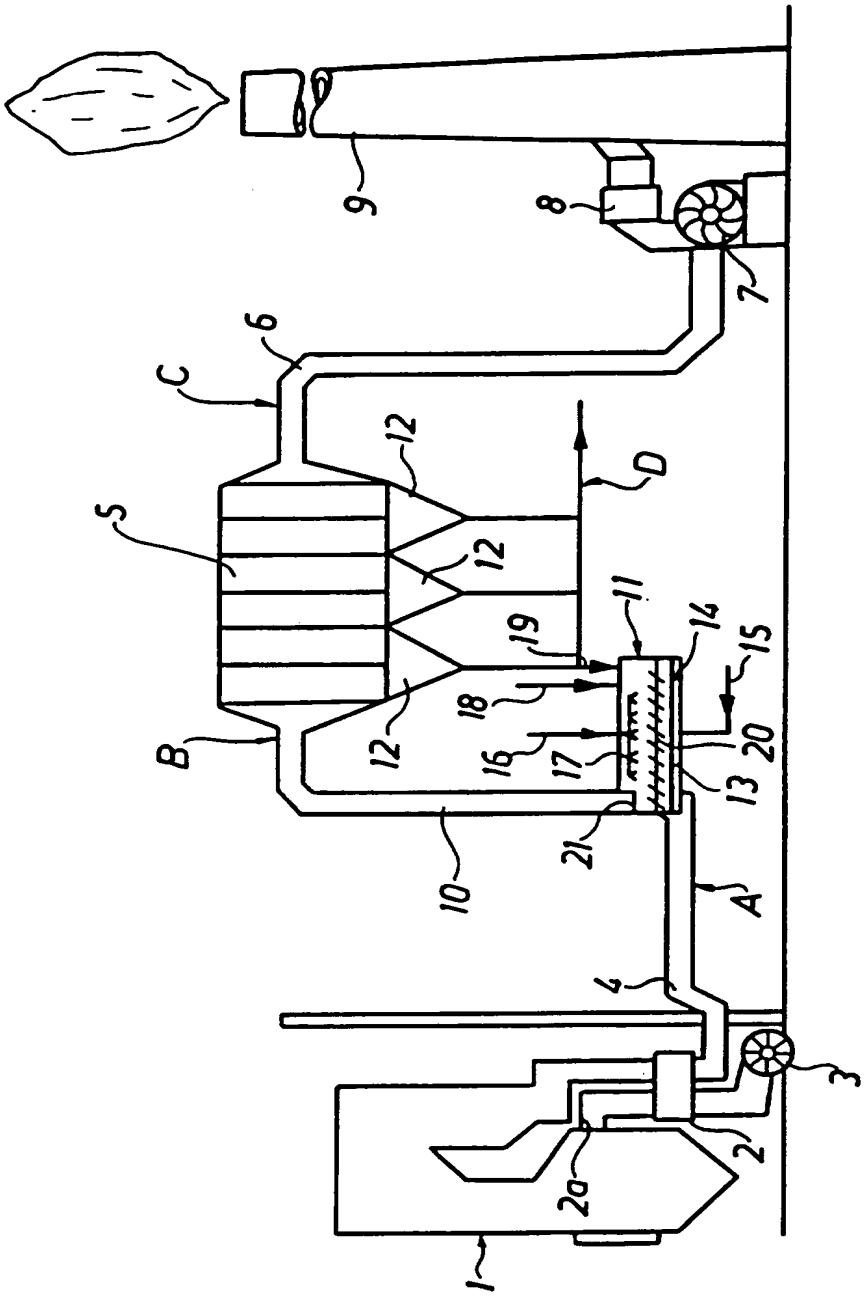

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/01403

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B01D 53/81, B01D 53/83, B01D 53/50
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 458095 B (FLÄKT AB NACKA), 27 February 1989 (27.02.89), figure 1, claim 1	1-3
A	WO 8804196 A1 (IMATRAN VOIMA OY), 16 June 1988 (16.06.88)	1-5
A	SE 453570 B (FLÄKT AB NACKA), 15 February 1988 (15.02.88)	1-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"B" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 March 1996	27 -03- 1996
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Information on patent family members

05/02/96

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-B- 458095	27/02/89	SE-A- 8602864	28/12/87
WO-A1- 8804196	16/06/88	AU-A- 1049488	30/06/88
SE-B- 453570	15/02/88	SE-A- 8504675	10/04/87